Treatment Guidelines for Pediatric and Adult Patients Presenting in the Outpatient Setting in Erie County with Uncomplicated Skin Abscesses Possibly Caused by Community-Associated Methicillin Resistant *Staphylococcus aureus* (CA-MRSA)

Erie County Department of Health

Updated January 2011

SUMMARY RECOMMENDATIONS

- Community-associated Methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is a very common cause of skin and soft-tissue infections (SSTIs) including skin abscesses presenting in Erie County, New York outpatient settings.

- Therefore, CA-MRSA should be considered in the differential diagnosis of all skin abscesses presenting in the outpatient setting.

- In general, incision and drainage (I&D) has been the recommended treatment for skin abscesses and should continue to be strongly considered as the primary treatment modality for all skin abscesses including those possibly caused by CA-MRSA.

- Given the evolving CA-MRSA public health problem, it is requested and suggested that specimens be obtained for culture and susceptibility testing from all skin abscesses for epidemiological and treatment purposes.

- I&D alone may not be adequate treatment for skin abscesses caused by CA-MRSA; empiric antimicrobial therapy that covers MRSA should be considered for patients presenting with skin abscesses in the outpatient setting especially if I&D is not performed.

- Recommended first line empiric antimicrobial therapy for skin abscesses includes trimethoprim-sulfamethoxazole (TMP-SMX).

    - In general and at this time, local CA-MRSA isolates have also been found to be sensitive to vancomycin, tetracyclines (including doxycycline and minocycline), rifampin, linezolid, and clindamycin.

    - If clindamycin is prescribed, evaluation for inducible resistance via double-disk diffusion test (D-zone) test is recommended.

    - The use of rifampin is only recommended in combination with other agents due to the potential for the development of resistance.

    - Empiric treatment should be re-evaluated once laboratory results become available.

- Decolonization is not routinely recommended, but may be appropriate in limited circumstances. Decolonization may be considered if:
    - Patient experiences recurrent infections from culture proven CA-MRSA, or

    - Multiple cases are diagnosed within a household or other crowded living situation, or

- Ongoing transmission occurs in the course of an outbreak (e.g., multiple members of an athletic team are infected)

- Discussion with the Erie County Department of Health is requested if decolonization is considered.

- Patient education on infection control, with emphasis on hand hygiene (washing with soap etc.), is strongly recommended.

- Single cases of CA-MRSA are not reportable to the Erie County Department of Health, but clusters of cases or outbreaks should be reported to (716)858-7697 or after hours at (716)961-7898.

- These guidelines do not address treatment of any other SSTIs including cellulites, and do not recommend any deviation from traditional treatment or antibiotic choice for these other SSTIs.

BACKGROUND

Staphylococcus aureus bacteria are a common cause of pneumonia, skin, surgical wound and bloodstream infections in the United States. Methicillin-resistant *Staphylococcus aureus* (MRSA) was first reported among hospitalized patients in the 1960s. Its emergence in the community, as community-associated MRSA (CA-MRSA) is more recent with increased reporting in the 1990s. The majority of these infections present as skin and soft-tissue infections (SSTIs).

DEFINITION

CA-MRSA is defined as MRSA infection found in persons with **NO** history of hospitalization or invasive procedures in the past year. These guidelines focus only on abscesses caused by CA-MRSA and are based on the Centers for Disease Control and Prevention (CDC) recommendations[1] and local expert opinion (meeting convened May 2007 to develop consensus guidelines).

SYNONYM(S)

CA-MRSA, Community MRSA, Non-hospital MRSA.

---

[1] Gorwitz RJ, Jernigan DB, Powers JH, Jernigan JA, and Participants in the CDC Convened Experts' Meeting on Management of MRSA in the Community. Strategies for clinical management of MRSA in the community: Summary of an experts' meeting convened by the Centers for Disease Control and Prevention. 2006. Available at http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca.html.

EPIDEMIOLOGY & DEMOGRAPHICS

Staphylococcus aureus (SA) is a gram-positive bacterium. It is commonly found in 30% of healthy human populations colonizing the nasopharynx, skin, and mucous membranes, while MRSA colonizes approximately 1%. Recent research suggests that the percentage of people colonized with MRSA may be increasing. A cross-sectional study that looked at MRSA colonization among healthy children found that in 2001, only one percent of children tested were colonized, compared to 9% of children tested in 2004[2]. In some communities, up to 75% of SA infections are MRSA[3]. Studies at the Women's and Children's Hospital of Buffalo (WCHOB) have reported 65-75% of SA isolates obtained from SSTIs among outpatients are MRSA (Dr. Howard Faden, personal communication). Overall, CA- MRSA accounts for approximately 12% of all MRSA infections with varied incidence geographically[4].

CA-MRSA prevalence may be higher in urban vs. rural areas, likely as a result of more crowded living conditions. Additional settings that facilitate transmission include frequent skin-to-skin contact between individuals, sharing of personal items and lack of personal hygiene. Hence, the prevalence may be greater among specific populations, such as military recruits, prison inmates, day care attendees, sports teams etc; however, most CA-MRSA-infected patients do not have recognized risk factors and are reported as isolated cases.

CA-MRSA disproportionately affects children, young adults, and individuals from racial minority groups or low socioeconomic status. Studies have not identified any consistent clinical risk factors that distinguish patients with CA-MRSA infection from patients with community associated Methicillin-susceptible SA (CA-MSSA) infection. Studies have found that CA-MRSA contacts are more likely to develop infection than contacts of CA-MSSA[5].

CA-MRSA has clinical, epidemiologic, and bacteriologic characteristics that are distinct from the better known healthcare-associated MRSA (HA-MRSA). However, this distinction seems to be waning with CA-MRSA and HA-MRSA now becoming indistinguishable clinically and microbiologically.

MRSA colonization occurs in the nose and at other sites including the pharynx, axillae, rectum, and perineum. Nasal MRSA colonization is not always present in individuals with active CA-MRSA infections. It is possible for individuals to be colonized with CA-MSSA and develop a CA-MRSA infection. Studies report that CA-MRSA strains account for a majority of pediatric outpatient/emergency room MRSA visits but remain a small percentage of outpatient adult MRSA. Compared to HA-MRSA,CA-MRSA is currently

---

[2] Creech et al. Increasing rates of nasal carriage of methicillin-resistant Staphylococcus aureus in healthy children. Pediatr Infect Dis J. 2005 Jul;24(7):617-21.

[3] Daum, RS. Skin and Soft-Tissue Infections Caused by Methicillin-Resistant Staphylococcus aureus N Engl J Med 2007;357:380-90.

[4] http://www.erie.gov/health/services/health_pros_alert153.asp (Accessed Oct 15 2007).

[5] Creech et al. Increasing rates of nasal carriage of methicillin-resistant Staphylococcus aureus in healthy children. Pediatr Infect Dis J. 2005 Jul;24(7):617-21.

resistant to fewer antibiotics, but CA-MRSA is becoming increasingly resistant to additional antibiotic classes.

CLINICAL PRESENTATION

Patients may complain of a "spider bite" but have no recollection of exposure. Patients may present with complaints of redness, swelling, pruritus and pain at the site of the inflammation. A history of recurrent skin abscesses should raise clinical suspicion for MRSA.

MRSA is an infection that spreads by direct skin-to-skin contact and lack of personal hygiene. No clinical or historical features reliably predict MRSA versus MSSA.

DIAGNOSIS

A presenting chief complaint of "insect or spider bite", abscesses, furuncles, boils, cellulitis or other SSTI symptoms, should raise suspicion of SA infection.

WORKUP

Obtain a medical history including recent hospitalizations and any invasive procedures. If patient complains of spider bite, ask the patient to recollect if any spiders were seen. Patients should be asked about abscesses in other household members or close personal contacts. Obtain a history of day care attendance, playing contact sports, or incarceration.

LABORATORY TESTS

It is important to obtain cultures of abscesses to guide therapy and monitor the extent of CA-MRSA infections in the community. Collect specimens for culture and antimicrobial susceptibility testing from all patients with abscesses or purulent skin lesions, particularly those with severe local infections, or history suggesting connection to a cluster of infections among epidemiologically linked individuals.

TREATMENT

INCISION AND DRAINAGE

Incision & Drainage (I&D) as a primary therapy for furuncles, other abscesses, and septic joints, should be performed routinely. Studies suggest that I&D is associated with better clinical outcomes[6]. If a clinician is unsure whether pus is present in a lesion, an attempt can be made to aspirate fluid from the lesion using an adequate size needle and syringe (e.g., a 16- to 19-gauge needle on a 10cc syringe). For small furuncles not amenable to I&D or collection of material for culture, moist heat may be satisfactory to promote drainage.

---

[6] Miller et al. A Prospective Investigation of Outcomes after Hospital Discharge for Endemic, Community-Acquired Methicillin-Resistant and -Susceptible *Staphylococcus aureus* Skin Infection. *Clinical Infectious Diseases*, volume 44 (2007), pages 483–492.

Some experts recommend that in immunocompetent patients with no systemic involvement and small abscesses (less than 5 cm), the infection can be managed with I&D with or without antimicrobial therapy[7]. If opting to treat with I&D alone, patients should be examined within 48 hours to assess response. CDC considers factors influencing such a clinical decision to include the severity and rapidity of progression and the presence of associated cellulitis, signs and symptoms of systemic illness, associated patient co-morbidities or immune suppression (e.g., diabetes mellitus, neoplastic disease, HIV infection), extremes of patient age, a difficult to drain abscess or one that can be associated with septic phlebitis of major vessels (e.g., central face), and lack of response to initial treatment with incision and drainage alone.

ANTIBIOTIC THERAPY

Empiric antimicrobial therapy may be initiated before culture and sensitivity results are available. In the absence of laboratory results, clinicians should treat with antimicrobials to which MRSA is susceptible. Once laboratory results are available, antimicrobial therapy should be re-evaluated.

SUSCEPTIBILITY PATTERNS:

Thus far, most CA-MRSA isolates are susceptible to trimethoprim-sulfamethoxazole (TMP-SMX), vancomycin, gentamicin, tetracyclines (including doxycycline and minocycline), rifampin (used only in combination with other agents), linezolid and clindamycin, although some SA isolates that appear erythromycin-resistant and clindamycin-susceptible by routine susceptibility testing exhibit *in vitro* resistance to clindamycin during therapy ("inducible resistance"). Since clindamycin resistance in MSSA is increasing, local experts recommend the use of TMP-SMX as a first-line therapy for lab confirmed CA-MRSA infections and for the empirical treatment of suspected CA-MRSA infections when lab confirmation is not possible.

CDC issued antibiotic-specific guidelines following a 2006 experts' meeting. Below are selected excerpts[8].

TRIMETHOPRIM-SULFAMETHOXAZOLE (TMP-SMX):

TMP-SMX is not approved by the United States Food and Drug Administration (FDA) for the treatment of any staphylococcal infection. However, there are several case reports describing the successful use of TMP-SMX to treat SA infections, including MRSA.

---

[7] Lee et al. Management and outcome of children with skin and soft tissue abscesses caused by community-acquired methicillin-resistant Staphylococcus aureus. Pediatric Infectious Disease Journal. 23(2):123-127, February 2004.

[8] Gorwitz RJ, Jernigan DB, Powers JH, Jernigan JA. Strategies for clinical management of MRSA in the community: summary of an experts' meeting convened by the Centers for Disease Control and Prevention. March 2006.

There are no data indicating that TMP-SMX is clinically effective for the treatment of SSTIs due to group A streptococcus (GAS). Clinicians should consider addition of an agent for GAS coverage, such as a beta-lactam agent or clindamycin, if this is an etiologic consideration (e.g., in patients with cellulitis).

CAUTION:
TMP-SMX is not recommended in women in the third trimester of pregnancy or in infants less than two months of age.

TETRACYCLINES (E.G., TETRACYCLINE, DOXYCYCLINE, MINOCYCLINE):

Doxycycline is FDA-approved for the treatment of *S. aureus* skin infections, but not specifically for those caused by MRSA.

CAUTION:
Tetracyclines are generally not recommended during pregnancy or for children under the age of eight years. There is little information available on clinical outcomes associated with the use of minocycline or doxycycline to treat infections caused by SA strains with *in vitro* tetracycline resistance.

CLINDAMYCIN:

Clindamycin is FDA-approved for the treatment of serious SA infections. Although not specifically approved for the treatment of MRSA, clindamycin has been used widely in the treatment of SSTIs with successful treatment reports.

A D-zone test should be performed to identify inducible clindamycin resistance in erythromycin-resistant, clindamycin susceptible *S. aureus* isolates. If empiric clindamycin therapy has been initiated and inducible clindamycin resistance is detected, response to therapy should be assessed. Monitor the patient closely to assure resolution of the infection if clindamycin therapy is continued. Consider changing to another agent if response to therapy has been unsatisfactory.

CAUTION:
Observational data suggest *Clostridium difficile*-associated disease may occur more frequently with clindamycin therapy as compared to other antimicrobial agents. Additionally, reports of clindamycin resistance in the WNY area are increasing, especially among MSSA isolates.

RIFAMPIN (SHOULD NOT BE USED AS A SINGLE AGENT):

Rifampin has been used to treat staphylococcal infections in combination with other antimicrobial agents that are active against *S. aureus* because rifampin achieves high concentrations in mucosal surfaces.

A theoretical benefit of including rifampin in an active MRSA infection treatment regimen is that it may promote MRSA carriage eradication. There is little information

available on the incremental benefit of adding rifampin for the treatment of staphylococcal infections.

CAUTION:
Resistant *S. aureus* strains can develop rapidly when rifampin is used as a single agent.

LINEZOLID:

NOTE: Consultation with an infectious disease specialist is suggested.

Linezolid is FDA-approved for the treatment of complicated skin infections in adults. However, Linezolid is rarely used because 1)clinical experience with linezolid in children is limited; 2) concerns of drug toxicities; and 3) very high drug costs.

CAUTION:
Linezolid use has been associated with a risk of dose- and duration-dependent reversible myelosuppression, principally thrombocytopenia, prompting recommendations for monitoring of complete blood counts in patients receiving linezolid for >2 weeks.

There have also been case reports of peripheral and optic neuropathy and lactic acidosis in patients receiving prolonged Linezolid therapy.

Although rare, linezolid resistance has been described in *S. aureus.*

SPECIAL CASES:

a. Consultation with an infectious disease specialist should be sought.
b. Fluoroquinolones and macrolides are not optimal choices for the empiric treatment of community-associated abscesses suspected to be caused by SA in areas with high MRSA prevalence.
c. Vancomycin remains a first-line therapy for severe infections possibly caused by MRSA. However, reports of *S. aureus* vancomycin resistance are increasing.
d. Other intravenous agents such as clindamycin, daptomycin, linezolid, quinopristin-dalfopristin, tigecycline, and Vancomycin may be appropriate to consider in some circumstances.
e. Intravenous antimicrobial agents are appropriate for patients with severe staphylococcal infections, particularly patients requiring hospitalization.
f. Final therapy decisions should be based on results of cultures and antimicrobial susceptibility testing.

DECOLONIZING REGIMENS:

Few data exist to support the use of agents to eliminate SA colonization, such as nasal mupirocin and antiseptic body washes containing chlorhexidine, for patients with MRSA infection or their close contacts.

If decolonization of a large cohort (e.g., household, classroom, athletic team, group home, correctional facility) is considered, clinicians should consult with an infectious disease specialist and the Erie County Department of Health at (716)858-7697 or after hours at (716)961-7898.

There is no single decolonization regimen recommended by the CDC. Erie County experts suggest the application of nasal mupirocin for five days, applied to the anterior nares, when decolonization is considered appropriate. When dealing with a defined cohort, whether decolonizing should be limited to SA-colonized individuals alone or applied to the entire cohort has not been established. However, it is recommended that all cohort members who receive decolonization regimens should do so simultaneously and care be taken to ensure compliance.

DISPOSITION

If empiric fluoroquinolones or macrolides are used, follow-up examination to assess response is suggested. Similar evaluation can be used to assess inducible clindamycin resistance. Close contacts should seek care if similar symptoms develop. Invasive MRSA infection can cause serious complications and can be fatal.

REFERRAL

Any abscess that cannot be drained in the office setting should be referred for a surgical consult.

REPORTING

Single cases of MRSA are not currently reportable to the health department. Outbreaks among people who share something in common (e.g. football players on the same team) are reportable and will be investigated as needed. If a cluster of cases is identified or suspected, please notify the Erie County Department of Health.

CONSIDERATIONS

COMMENTS

Currently, New York State law does not mandate MRSA-infected outpatient isolation. In a health care setting, isolation and treatment is recommended for multiple MRSA cases.

PREVENTION

The most efficient way to avoid contracting and/or spreading MRSA is to maintain proper hand hygiene. Frequent hand washing, with soap and water, or waterless hand sanitizers, is recommended.

Persons with active infection should keep the wound/abscess covered with a clean and dry bandage. CDC recommends that persons who cannot maintain adequate hygiene and keep wounds covered with clean, dry bandages should be excluded from activities where close contact with other individuals occurs, such as daycare or athletic practice, until their wounds are healed.

Disinfection of any surfaces potentially contaminated and posing a risk for spread should be promptly undertaken.

Regimens to eliminate SA colonization can be used in healthcare settings to prevent autoinfection among colonized patients. Although appropriate decolonization regimens (agents and administration schedules) have not been established for community settings, decolonization regimens can also be employed in community MRSA outbreaks. These regimens can include various combinations of topical and systemic antimicrobial agents and antiseptic body washes. However, data on their effectiveness are unclear. Although recolonization is common, data indicate that intranasal mupirocin can be effective at eliminating SA colonization in the short term. Since resistance to systemic and topical agents during decolonization therapy has been described, care should be used before widespread use of such interventions.

INFECTION CONTROL:

Standard infection control precautions should be used for all patients. This includes performing hand hygiene (hand washing or using alcohol hand gel) after touching body fluids or contaminated items (whether or not gloves are worn), between patients, and when moving from a contaminated body site to a clean site on the same patient; wearing gloves when managing wounds; and wearing gowns and eye protection as appropriate for procedures that are likely to generate splashes of body fluids.

Exam room surfaces should be cleaned with a United States Environmental Protection Agency registered hospital detergent/disinfectant, in accordance with label instructions, or a 1:100 solution of diluted bleach (1 tablespoon bleach in 1 quart water).

PATIENT/FAMILY EDUCATION

Patient education is a critical case management component. Clinicians should explain to patients the significance of hand hygiene and keeping the wound covered in limiting spread. The importance of a shower with disinfecting body soap should be mentioned. Disinfection of potentially contaminated surfaces should be strongly recommended.

Clinicians should routinely ask about similar cases among household members and other close contacts. Clinicians should educate patients or their care-takers, and when possible, household members, on methods to limit further spread of infection in their household and among other close contacts.

If a potential outbreak of cases in a defined cohort outside of a single household (e.g., school, athletic team) is identified, the Erie County Department of Health should be notified.

Information is available from the Centers for Disease Control and Prevention: http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca_public.html#5,

New York State Department of Health: http://www.health.state.ny.us/diseases/communicable/staphylococcus_aureus/methicillin_resistant/fact_sheet.htm

Erie County Department of Health: http://www.erie.gov/health/mrsa.asp.

Information can also be obtained from Erie County Department of Health by calling (716) 858-7697.

SUGGESTED READING:

Gorwitz RJ, Jernigan DB, Powers JH, Jernigan JA. Strategies for clinical management of MRSA in the community: summary of an experts' meeting convened by the Centers for Disease Control and Prevention. March 2006.

REFERENCES:

1. Abrahamian FM and Snyder EW, Community-associated Methicillin-resistant Staphylococcus aureus : Incidence, clinical presentation, and treatment decisions, Current Infectious Disease Reports. Vol 9, No. 5, Sep 2007, 391-397.
2. Behari P et al, Transmission of methicillin-resistant Staphylococcus aureus to preterm infants through breast milk., Infect Control Hosp Epidemiol. 2004 Sep;25(9):778-80.
3. Brumfitt W, Hamilton-Miller J. Methicillin-resistant Staphylococcus aureus. New Engl J Med 1989;320
4. Chang S, Sievert DM, Hageman JC, Boulton ML, Tenover FC, Downes FP, et al. Infection with vancomycin-resistant Staphylococcus aureus containing the vanA resistance gene. N Engl J Med. 2003;348:1342–7.
5. Crawford SE, Boyle-Vavra S, Daum RS. Community associated Methicillin-resistant Staphylococcus aureus. In: Hooper D, Scheld M, eds. Emerging infections. Vol. 7. Washington, DC: ASM Press, 2007:153-79. (In Daum, 2007).
6. Daum, RS. Skin and Soft-Tissue Infections Caused by Methicillin-Resistant Staphylococcus aureusN Engl J Med 2007;357:380-90.
7. Deurenberg et al, The molecular evolution of Methicillin-resistant Staphylococcus aureus, Clin Microbiol Infect 2007; 13: 222–235
8. Emori TG, Gaynes RP. An overview of nosocomial infections, including the role of the microbiology laboratory. Clinical microbiology reviews, 1993, 6(4):428-42.
9. Fridkin et al, Methicillin-Resistant Staphylococcus aureus Disease in Three Communities. N Engl J Med 2005;352:1436-44.
10. Gould IM, MRSA bacteraemia, Int. J. Antimicrob. Agents (2007), doi:10.1016/j.ijantimicag.2007.06.023.
11. http://en.wikipedia.org/wiki/Staphylococcus_aureus.
12. http://www.cdc.gov/ncidod/aip/research/mrsa.html.

13. http://www.erie.gov/health/services/health_pros_alert153.asp (Accessed Oct 15 2007).
14. http://www.gsbs.utmb.edu/microbook/ch012.htm
15. http://www.medscape.com/viewarticle/417452_3 from Infect Med 16(2):122-128, 1999. (Accessed Oct 15 07).
16. Jernigan JA, Arnold K, Heilpern K, Kainer M, Woods C, Hughes JM. Methicillin-resistant Staphylococcus aureus as community pathogen [conference summary]. Emerg Infect Dis, 2006 Nov. Available from http://www.cdc.gov/ncidod/EID/vol12no11/06-0911.htm
17. www.shea-online.org/Assets/files/2007_CA-MRSA_Abstracts.pdf
18. Kuehnert et al. Methicillin-Resistant-Staphylococcus Aureus Hospitalizations, United States. Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 11, No. 6, June 2005
19. Laupland KB, Church DL, Mucenski M, Sutherland LR, Davies HD. Population-based study of the epidemiology of and the risk factors for invasive Staphylococcus aureus infections. J Infect Dis.2003;187:1452–9.
20. Lesse AJ, Mylotte JM, Clinical and molecular epidemiology of nursing home-associated Staphylococcus aureus bacteremia, Am J Infect Control. 2006 Dec;34(10):642-50.
21. McDougal et al. Pulsed-field gel electrophoresis typing of Oxacillin-resistant Staphylococcus aureus isolates from the United States: establishing a national database. J Clin Microbiol 2003;41:5113-20.
22. Moran et al. Methicillin-resistant S. aureus infections among patients in the emergency department. N Engl J Med 2006;355:666-74.
23. Morgan, MS. International Journal of Antimicrobial Agents 30 (2007) 289–296.
24. N.E. Bilal and M. Gedebou Staphylococcus aureus as a paradigm of a persistent problem of bacterial multiple antibiotic resistance in Abha, Saudi Arabia, Vol. 6, Issue 5/6, Sep-Nov 2000, Page 948-954.
25. Naimi et al, Comparison of Community and Healthcare associated MRSA infection, JAMA 2003;290:2976-2984.
26. Noskin et al, National Trends in Staphylococcus aureus Infection Rates: Impact on Economic Burden and Mortality over a 6-Year Period (1998–2003), Clin Infect Dis., Volume 45(2007), pages 1132 – 1140.
27. Pannarej et al, Infective pyomyositis and myositis in children in the era of community-acquired, methicillin-resistant Staphylococcus aureus infection. Clin Infect Dis. 2006 Oct 15;43(8):953-60. Epub 2006 Sep 1.
28. Purcell K, Fergie J. Epidemic of community-acquired Methicillin-resistant Staphylococcus aureus infections: a 14-year study at Driscoll Children's Hospital. Arch Pediatr Adolesc Med 2005;159:980-5.
29. Shorr, Epidemiology of Staphylococcal Resistance, CID 2007:45 (Suppl 3). S171.
30. Staphylococcal resistance revisited: CA-MRSA-an emerging problem for management of Skin and Soft Tissue Infections, Curr Opin Infect Dis. 2003 Apr ;16 (2):103-24
31. Stevenson KB, Searle K, Stoddard G, Samore MH. Methicillin-resistant Staphylococcus aureus and Vancomycin-resistant enterococci in rural communities, western United States. Emerg Infect Dis, 2005 Jun. Available from http://www.cdc.gov/ncidod/EID/vol11no06/05-0156.htm
32. Styers et al, Laboratory-based surveillance of current antimicrobial resistance patterns and trends among *Staphylococcus aureus*: 2005 status in the United States, *Annals of Clinical Microbiology and Antimicrobials* 2006, 5:2.
33. Todar, Kenneth, 2005. http://textbookofbacteriology.net/staph.html
34. Van DE Griend et al, Community-Associated Methicillin-Resistant Staphylococcus aureus: An emerging cause of bloodstream infection in Iowa. Poster with CTRL#3131.
35. Voss A, Doebbeling BN. The worldwide prevalence of Methicillin-resistant Staphylococcus aureus. International journal of antimicrobial agents, 1995, 5: 101-6.

36. Weber JT, Courvalin P. An emptying quiver: antimicrobial drugs and resistance. Emerg Infect Dis. 2005;11(6):791-793.
37. Hakim H, Mylotte JM, and Faden H. Morbidity and mortality of Staphylococcal bacteremia in children. Am J Infect Control. 2007 Mar;35(2):102-5.
38. Schentag JJ, Hyatt JM, Carr JR, Paladino JA, Birmingham MC, Zimmer GS, Cumbo TJ. Genesis of methicillin-resistant Staphylococcus aureus (MRSA), how treatment of MRSA infections has selected for vancomycin-resistant Enterococcus faecium, and the importance of antibiotic management and infection control. Clin Infect Dis. 1998 May;26(5):1204-14.
39. Chang FY, Peacock JE Jr, Musher DM, Triplett P, MacDonald BB, Mylotte JM, O'Donnell A, Wagener MM, Yu VL. Staphylococcus aureus bacteremia: recurrence and the impact of antibiotic treatment in a prospective multicenter study. Medicine (Baltimore). 2003 Sep;82(5):333-9.
40. Tsuji BT, Rybak MJ, Cheung CM, Amjad M, Kaatz GW. Community- and health care-associated methicillin-resistant Staphylococcus aureus: a comparison of molecular epidemiology and antimicrobial activities of various agents. Diagn Microbiol Infect Dis. 2007 May;58(1):41-7. Epub 2007 Feb 14.

ACKNOWLEDGEMENTS:

The Erie County Department of Health gratefully acknowledges the many contributions of area health professionals in the development of these guidelines.